

REMARKS

Claims 2-10 and 14-18 are pending herein. Claim 1 has been cancelled in favor of new claim 15. Claims 12 and 13 have been withdrawn from consideration by the U.S. Patent and Trademark Office. Claims 2-10 have been amended to depend from claim 15. Claims 2, 5, 9 and 14 have been amended to correct matters of form. Claim 14 has been further amended as supported by page 28, lines 15-25 of the present specification. Attached hereto as pages 10-12, pursuant to Rule 1.121(c)(1)(ii), is a marked-up version of the amended claims.

New claims 17 and 18, which depend from claims 15 and 14, respectively, have been added as supported by Fig. 1 of the present application.

1. Applicants affirm the provisional election to prosecute claims 1-10 and 12-14. Claims 12 and 13 have been withdrawn from consideration as being drawn to a non-elected invention, and thus have been cancelled without prejudice or disclaimer. Applicants reserve the right under 35 USC §121 to file a divisional application for the non-elected claims.

2. Claims 1, 2 and 14 were rejected under §102(a) over Nakazawa, Ushioda, Shigemura or Hiraishi. With respect to claim 1, this rejection is moot in view of the cancellation of claim 1. To the extent that this rejection might be applied against new claim 15 and the amended claims, it is respectfully traversed.

With reference to Fig. 1 of the present application, pending independent claims 14 and 15 each recite, among other things, that a plurality of cells 3 are defined by piezoelectric/electrostrictive (P/E) elements 4, 6 extending substantially perpendicularly from base plate 2. A cover plate 7 joins top portions of adjacent P/E elements 4, 6 to one another to define one of the plurality of cells. Claim 15 recites that the side walls of the P/E elements

are formed by firing only. Claim 14 has been amended to include the P/E elements formed by firing only limitation.

Applicants discovered that the durability and reliability of the actuator cells could be enhanced by employing a firing operation, without the need for a machining step, to form the P/E element side walls of each of the cells. That is, unlike the prior art discussed below, because no machining process is used, the occurrence of unwanted micro cracks on the side wall of the P/E elements or fractures inside the P/E crystal grains can be beneficially prevented (specification page 28, paragraph [0039]).

Nakazawa and Ushioda are assigned to the same assignee (NEC Corporation) and disclose ink jet recording heads having essentially the same structure. With reference to Figs. 1 and 2 of Ushioda and Nakazawa, respectively, the ink jet recording head includes channels 1d for example, formed in piezoelectric substrate 11. The ink channels include P/E side walls 3a-3d which function as P/E elements.

With reference to column 6, lines 24-28 of Nakazawa, it is disclosed that the piezoelectric substrate 11 is subjected to a mechanical grinding, such as by a dicing saw, to form a plurality of ink and dummy channels, which are arranged alternately with one other. Conversely, and as explained above, pending independent claims 14 and 15 each recite that the P/E element side walls are formed by firing only. The "formed by firing only" limitation provides a structurally distinct product over Ushioda's and Nakazawa's ink jet head because the propagation of micro cracks can be effectively prevented during driving of the P/E cells. Again, micro cracks and fractures inside the P/E crystal grains in the P/E element side walls result from machining processes, such as the dicing saw method disclosed in Nakazawa, used to form the P/E element side walls (see page 5, lines 7-21 of the present specification).

Shigemura (also assigned to NEC) discloses an ink jet recording head. With reference to Fig. 2 of Shigemura, the ink jet recording head includes, for example, ink and dummy channels 1ab and 2bc, respectively, formed in P/E body 11. P/E side walls 3a-3e extend from P/E body 11 and have a top plate 8 positioned thereon.

Similar to the discussion above with respect to the rejections over Nakazawa and Ushioda, Shigemura discloses that piezoelectric body 11 is machined using a dicing saw to form the ink and dummy channels (column 5, line 66 -- column 6, line 6 of Shigemura). Again, pending independent claims 14 and 15 each recite that the P/E side walls are formed by firing only. The benefits associated with forming the P/E side walls by firing only and the disadvantages of employing machining operations have been discussed above.

With reference to Fig. 1 of Hiraishi, an ink jet head includes, for example, ink and dummy channels 5dc and 6cd, respectively, formed in insulating substrate plate 1. Barriers 2b-2e are formed from a piezoelectric material and extend from insulating support plate 1. A common insulator lid 3 is positioned on the ink and dummy channels.

Similar to all of the applied art discussed above, Hiraishi discloses that the ink and dummy channels are formed using a dicing saw or a wire saw (column 8, lines 1-5). As explained above, the use of such machining operations to form the surface of the P/E side walls (i.e., barriers) disadvantageously results in a relatively weaker, less reliable P/E element due to the propagation of micro cracks in the P/E element side walls during actuation of the P/E elements. Again, the prior art drawbacks are eliminated by forming the P/E side walls by firing only, as is recited in pending independent claims 14 and 15.

In view of all of the foregoing, reconsideration and withdrawal of the §102(a) rejection over Nakazawa, Ushioda, Shigemura and Hiraishi are respectfully requested.

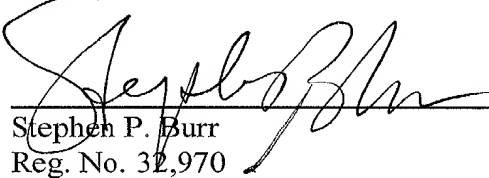
3. Claims 3-10 were rejected under §103(a) over Hiraishi, Shigemura or Ushioda.

Applicants respectfully submit that the arguments submitted above distinguish claim 15 from Hiraishi, Shigemura and Ushioda. Since claims 3-10 depend directly from claim 15, claims 3-10 are also believed to be allowable over the applied art.

If the Examiner believes that contact with Applicants' attorney would be advantageous toward the disposition of this case, the Examiner is herein requested to call Applicants' attorney at the phone number noted below.

The Commissioner is hereby authorized to charge any additional fees associated with this communication or credit any overpayment to Deposit Account No. 50-1446.

Respectfully submitted,



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2. (Amended) A cell driving type actuator according to claim 15~~1~~, wherein the polarization field of said piezoelectric/electrostrictive elements and the driving electric field are aligned in the same direction.
3. (Amended) A cell driving type actuator according to claim 15~~1~~, wherein the degree of profile for the surface of said cells is approximately 8 μm or less.
4. (Amended) A cell driving type actuator according to claim 15~~1~~, wherein ~~the~~a ratio of ~~the~~a minimum spacing between the adjacent piezoelectric/electrostrictive elements forming said cells to ~~the~~a minimum spacing between said base plate and said cover plate is approximately 1:2 to 1:40.
5. (Amended) A cell driving type actuator according to claim 15~~1~~, wherein ~~the~~a ratio of ~~the~~a spacing between ~~said cell and the adjacent cells~~ to ~~the~~a minimum spacing between said base plate and said cover plate is approximately 1:2 to 1:40.
6. (Amended) A cell driving type actuator according to claim 15~~1~~, wherein ~~the~~a minimum spacing between the adjacent piezoelectric/electrostrictive elements forming said cells is approximately 60 μm or less.
7. (Amended) A cell driving type actuator according to claim 15~~1~~, wherein the spacing between ~~said cell and the adjacent cells~~ is approximately 50 μm or less.

VERSION WITH MARKINGS TO SHOW CHANGES MADE
Amended claims